Self Defence Device with GSM alert and GPS tracking with fingerprint verification for women safety

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Abstract— **A new approach is given towards the security of women in the form of a device. The objective of the device is to provide women with a tool that can provide them security and ensure their safety in case of any mishap. The paper proposes a better approach which makes use of a high voltage current producing circuit which will be used to stun the opposition for few seconds. The fingerprint module for activation of device, electric shock producing circuit, GSM/GPS module for alerting and location tracking all interfaced with a microcontroller to design a small baton shaped device which will be handy and easily portable.**

Keywords- security, GSM, GPS, FPR, Nano, HVLC

I. INTRODUCTION

Security of women is a major topic of concern in India. Most of the women in India have experienced some form of violence or harassment in public. There is a growth in crimes related to women harassment and the main reason that a woman is being a victim is lack of public security and inability of a woman to defend her. In order to be able to protect herself, she must train herself through various self-defense courses, which is not possible for every woman to enroll into these courses. Regarding this issue there are various applications available on mobile platform that are meant specially for women safety, but these applications doesn't guarantee security at the time of the incident because these applications only do the job of informing people concerned about women's safety and could not assist her to defend herself neither the availability of the concerned people is guaranteed at the time of the incident.

In some countries the use of self-defense equipment is legitimate. These equipments like stun gun and pepper spray are developed for a woman to defend herself by attacking the opposition using these equipments, but if the victim needs assist or she is in secluded area with no one to help then these equipments can be termed as temporary safety equipments. Also these devices can be misused if fallen in wrong hands [8].

To overcome the drawbacks of women security applications and self defence equipments, an algorithm is developed that works similarly like a security application as well as self defence equipment. Basically it's a device that clubs these two ideas which would serve as a better reinforcement for women's safety. Generally this device produces an electric shock at its tip along with sending alert message to the people concerned as well as the information regarding the exact location of the user on activation of the device via users fingerprint. This device aims at providing a sense of security and freedom to travel anywhere without concerning about her safety.

Fingerprint recognition refers to an authentication technique which is dependent on measuring human characteristics that can be verified automatically. Each and every person has their unique personal traits which distinguish them whenever there is a need for an authentication purpose. It includes a fingerprint, iris, face, retina and voice recognition. This device makes use of fingerprint recognition for its activation. Due to fingerprints unique identity, any other person other than the authorized user in possession of this device will not be able to use it, preventing any misuse of the device's high voltage stunning capabilities to any one in contact [10].

As it is necessary to interface various peripheral devices with the microcontroller, it is important to study about the interfacing techniques. Following are the papers which were helpful for getting ideas and working of different peripherals.

Mrinmoy Dey, Md. Akteruzzaman Arif and Mahmud Md. Asif, [1] proposed algorithm for vehicle theft. There has been a rise of vehicle and fuel theft due to which the tracking of vehicles has become popular. Vehicle thefts always happen in parking and sometimes driving in unsecured places. This paper explores how to avoid this kind of stealing and provides security to the vehicles. This system contains single-board embedded system which has global system for mobile (GSM) and global positioning system (GPS) along with a microcontroller installed in the vehicle. This allows the system to track the object and provides the most up-to-date information about on-going trips. Fingerprint matching is done in the system which is implemented here to ensure that correct person is driving.

Bharati M Nelligani, Dr. N V Uma Reddy, Mr.Nithin AwastiSmart [2] proposed algorithm for ATM security. This paper gives the detailed approach towards ATM security. Here, the ATM security system is made with the help of embedded systems. In this proposed system RFID card is used as ATM card, fingerprint module is used for identification process. If there is false fingerprint authentication, SMS will

be sent to two main stations along with to the authorized user of that RFID card. Also using GPS location the location of the cashbox is tracked if it is stolen.

A team of students from SRM University of Chennai in India has came across with the idea of SHE – Society Harnessing Equipment. This equipment is attached with garments. It is embedded with sensor and electric shock circuit, which can generate 3800kV which can help the victim to escape. In case of multiple attacks it can send around 80 electric shocks [9]

Manisha Mohan an Indian Scientist [3] developed a wearable sensor which is like a sticker that can detect sexual assault in real time and quickly alert nearby people through a high sound buzzer as well as the victim's closed ones and family members to seek help at the time of incident. She developed a sensor which can be attached to any piece of clothing. The sensor which is made could be trained in such a way that it could be able to detect a person undressing themselves or a person is undressed forcefully. This sensor based project allows detecting the signs of assault even if the victim is unconscious or not in the position to defend or fight against the assaulter, such as in case of hospitalized or handicapped patients. This wearable sensor is integrated to a smartphone via Bluetooth. The smartphone can trigger a loud noise which will alert the nearby people to seek help as well as send a message with the location of the victim to pre-defined phone numbers of family members or public servants such as police. The sensor works in two modes viz. passive mode and active mode. Whenever a user encounters any threat approaching towards them, the alarm is set off loud by its own and button is pressed. This can be executed in passive mode. While in active mode, the sensor will try to detect signals or disturbance from the external environment. If someone is trying to remove off clothing from the victim's body, the sensor will detect the disturbance and send to smartphone to confirm whether the act was done with consent. Victim has a time of 30 seconds to respond to the message otherwise the phone will emit a loud noise to alert the user and nearby people. The user needs to stop the alarm within the next 20 seconds using a password saved first otherwise the smart phone application will send distress signals along with the location to concerned people such as family or friends. But the problems of this device were that this wearable is integrated with phone for alarming but the loudness of phone's speaker is not sufficient to alert the nearby people and woman does not have an option of defending herself with the use of this device.

II. SELECTION OF COMPONENTS

The selection of components should be such that the size of the device should be compact and the response time taken by each and every module should be very less for quick output.

A. Fingerprint module

There are many types of fingerprint scanners available in the market. Looking at the availability of these modules, INVNT 3, Cogent CSD 200, R305 modules were bulky. The project aims to design a compact device. It was found that GT 511C3 was a compact module as well as having the following specifications shown in Table.I which is required in a fingerprint module. Therefore, fingerprint module GT-511C3 [4] is used. GT-511C3 has an optical sensor which scans a fingerprint and the microcontroller and its software provides

functionality to process the fingerprint which is scanned before. The two UART pins are used for the communication with the Fingerprint scanner module and the other two pins are ground and input voltage. The two UART pins will be interfaced with the microcontroller's digital I/O pins [4].

TABLE I. SPECIFICATIONS OF GT511C3

Parameter	Value
Operating voltage	DC 3.3 ~ 6V
Sensor	Optical Sensor
Maximum number of fingerprints	200 fingerprints
Matching mode	1:1, 1:N
Identification time	<1.0 sec

B. Microcontroller

Considering the design of this device, the microcontroller should be selected such that it should occupy less space to achieve compactness. As many peripherals are to be interfaced with the microcontroller, it should have fast processing speed. To have high processing speed and low power consumption, LPC2148 ARM based microcontroller was found to be an ideal one for the project. But, the microcontroller was not compact as per the requirement in the project. Searching for various microcontroller with all the specifications mentioned in Table.II, ARDUINO NANO was the suitable for the device. Thus, microcontroller used for the device is ARDUINO NANO [5].

TABLE II. SPECIFICATIONS OF ARDUINO NANO

Parameter	Value
Microcontroller	ATmega328
Operating voltage	5V
Flash memory	32 KB
SRAM	2 KB
Clock speed	16 MHz
Analog I/O and Digital I/O pins	8 and 22 pins
PCB size	18×45 mm

C. GSM/GPS Module

GSM and GPS module are separately available in the market. As space constraint is a major issue for designing a compact device, SIM 808 [6] is the combined GSM and GPS module. The required specifications of the module is shown in Table.III [6].

ABLE III. SPECIFICATIONS OF SIM808

Parameter	Value
Power supply	3.4V ~ 4.4V
Physical characteristics	Size: 24*24*2.6 mm Weight: 3.5 g
Frequency bands	SIM 808 Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900
GPRS connectivity	GPRS multi-slot class 12 (default) GPRS multi-slot class 1 ~ 12

III. SYSTEM DESCRIPTION

Many women security applications have been introduced for the safety of women as these applications have provision of informing and updating her closed ones by sending them a message with her location using GPS.
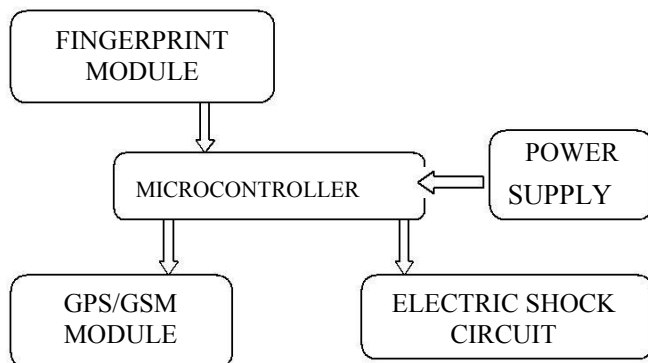

Fig. 1. Block diagram of Self Defence Devic with fingerprint verification.

The project aims to design a Self Defence Device with fingerprint verification which on the recognition of an authorized fingerprint will generate an electric shock at the tip of the device for a particular period of time and this electric shock coming in contact with the opposition will stun the opposition for few seconds. As soon as an authorized fingerprint is recognized, an alert message with the current location of a woman will be send to her closed ones so that till the time someone comes forward to help her, she will be self equipped to defend herself from the danger.

Fig. 1 shows block diagram of self Defence Device with fingerprint verification showing interfacing of fingerprint module,GPS and GSM module and electric shock circuit. Microcontroller ARDUINO NANO is used for interfacing and controlling with various pheripheral devices..GT-511C3 is a fingerprint model to scan the fingerprint and communicate with Microcontroller using UART.SIM 808 combined GPS and GSM module is used to send the remote position to relative of woman in threat. Electric shock circuit will generate high voltage shock coming in contact with device.

A. Interfacing of Fingerprint Module with Microcontroller

Fingerprint module selected is GT-511C3. This module has four pins viz transmission, reception, 5V input and ground. The FPR module should be operated at maximum voltage of 5V.

FPR module is communicating with arduino using serial communication.Before connecting FPR module with Nano software serial pins is defined using Arduino IDE software. The pin no. 7 is defined as software transmission and pin no. 8 as software reception for arduino nano. The FPR transmission pin no. is connected directly to the pin no. 8 and reception pin is connected via a voltage divider circuit to pin no. 7. After this connection finger prints of user are stored with id number in a enrollment process. The Fingerprint module can store up to 200 fingerprints.The SDK software is used for the enrollment process

B. Interfacing GPS & GSM Module with Microcontroller

The GPS & GSM module selected is SIM 808. This module integrates GSM and GPS in single module. The SIM 808 module is connected to Nano via hardware

UART pins. The transmission pin of SIM 808 is connected to pin no. 0 (reception pin of nano) and reception pin no. 1 (transmission pin of nano). The transmission pin of SIM 808 is connected to pin no. 0 (reception pin of nano) and reception pin no. 1 (transmission pin of nano) as shown in Fig. 2. The module requires a supply voltage of 5V-12V which is provided by the microcontroller 5V pin. The AT commands via UART of GPS are used to obtain the coordinates of the location and send this location via GSM. The coordinates are latitude and longitude values of that particular location.
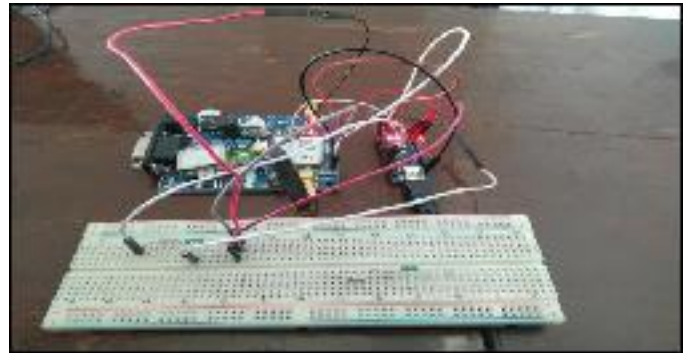
Fig. 2. Interfacing of GT511C3 and SIM 808 with Nano.

C. High voltage low current electric shock circuit. [7]

The High voltage circuit shown in Fig. 3. works on the principle of blocking oscillator concept. Sustainable oscillations are obtained with R1 and C1. Frequency of oscillation is determined by R1 and C1. R1 makes sure that transistor never comes within an unsafe zone while adjusting the preset. TR1 is made with smallest FE type of core. The power supply required to operate the circuit is 3V DC.

When power supply is given to the circuit designed, the centre tapped transformer and transistor instantly starts oscillating at the high frequency which is specified before. Therefore the battery current passes across the transformer through its windings. Due to above Switching, there is generation of high induced voltage across the secondary winding of TR1. The voltage induced across secondary winding of TR1 is around 200V. Further the above voltage is lifted to a suitable voltage level such that a flying spark is generated. This is done by a charge pump circuit used at the output of TR1.This network lifts the output voltage from 200V to 600V. The bridge rectifier rectifies this high voltage and 2uF/1kV capacitor steps up the voltage. A flying spark is generated if the terminals are held at a relatively closer distance.

Fig. 3. High Voltage Low Current circuit. [7]

IV. SYSTEM DESIGN

The device is designed like a portable baton. The microcontroller requires supply voltage of 3-5V. The FPR module, SIM 808 and electric shock circuit are interf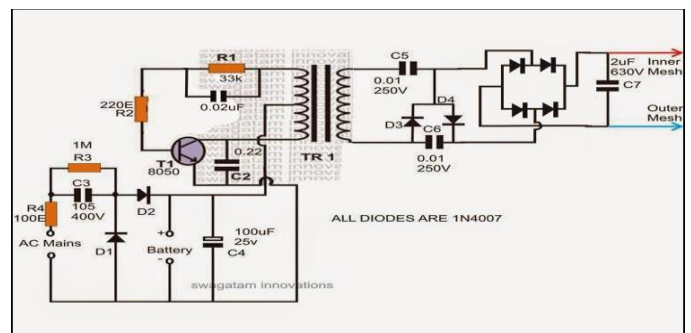aced to the microcontroller. The FPR module shown in Fig. 4 is connected to the software UART pins of the microcontroller. The SIM 808 module is connected to the hardware UART pins of the microcontroller and electric shock circuit is connected to the output pins defined in the program of microcontroller.
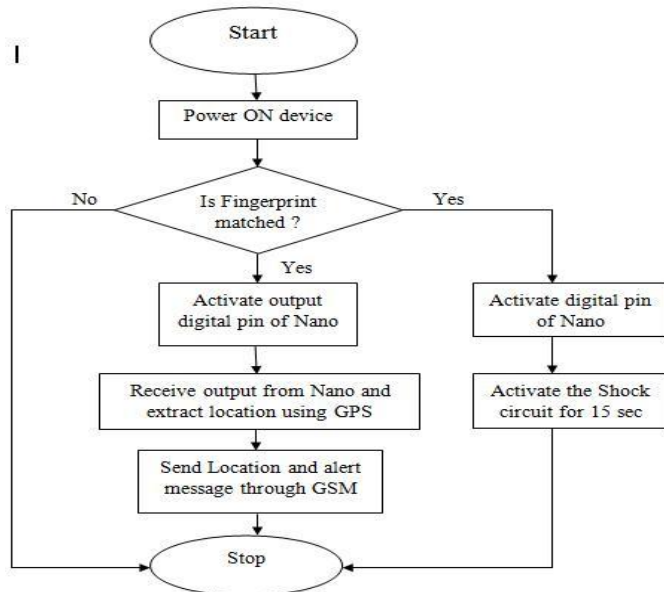

Fig. 4. Flowchart of operation of Device.

When the power is switched on along with microcontroller, the FPR and SIM 808 module also get ON. The FPR module then matches for the fingerprint of the registered user. If the fingerprint entered by the user matches with the fingerprint stored in the database, then the microcontroller gives high logic on the output pins. The electric shock circuit gets activated and generates a high voltage low current output at the output end of the circuit. The program fed inside the microcontroller is such that the electric shock circuit remains activated for a time of 15 sec. After 15 sec, the shock circuit becomes OFF. As shown in Fig. 2, at the same time when fingerprint recognition is done the SIM 808 module starts extracting the location of the user through GPS module. The location is obtained in terms of coordinates of latitude and longitude. This location is sent to the user's family members along with an alert message through GSM module.

V. RESULTS

Result is divided into three stages which are as follows

A. Stage 1-Fingerprint recognition

In the enrollment process the user's fingerprint is stored as a template and given an id number. The FPR asks for the fingerprint to be pressed as shown in Fig. 5. During the recognition process, matching is done between the stored fingerprint and the fingerprint of the user. If it matches with the stored fingerprint, then "Verified id" along with its id number is displayed.
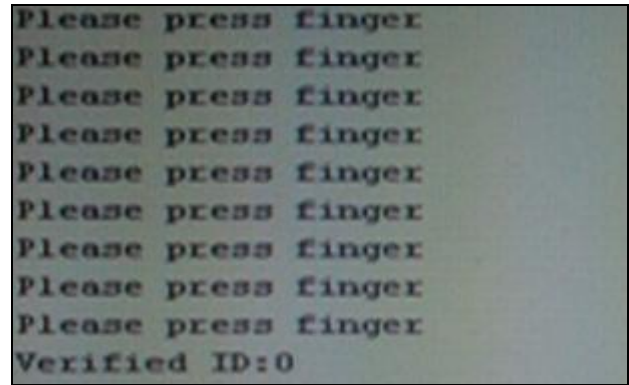
Fig.5 Fingerprint recognition process

B. Stage 2-Activation of High Voltage Low Current circuit

The HVLC circuit is connected to digital pin number 4 of ARDUINO NANO. This pin gets activated on the fingerprint recognition of the user. This pin is activated for 15 secs, after that the pin will be deactivated and the power to the HVLC circuit will be cut off. The HVLC circuit is powered by a 3V rechargeable battery. When the HVLC circuit is powered on, a flying spark is generated at the two end prongs of the device as shown in Fig. 7. The voltage generated is about 1KV with current rating of 2 mA. This spark will be such that it will stun the opposition

Fig. 6 Before fingerprint recognition power to HVLC is OFF

Fig. 7 After fingerprint recognition power to HVLC is ON

C. Stage 3-Sending of message along with the location through SIM 808 module

As fingerprint of the user is verified, the microcontroller sends AT command to SIM 808 module which extracts the location of the user through GPS. Once the GPS information is obtained AT command for sending the message along with the obtained location is sent to SIM 808 module as shown in Fig. 8. Following this, the GPS information is sent to the registered number.

Fig. 8 Extraction of GPS information and sending of message using SIM 808

VI CONCLUSION

There are many devices which are developed for women's safety but none of the device integrates GSM/GPS alerting and location tracking along with offensive capabilities. The applications which are already used for the women safety do not have any provision for defending herself and does not ensure safety till the messages are sent to the victim's closed ones and they arrive at a place of incident and save her from the mishap. The proposed design for Biometric Self Defense Device with GSM Alert and GPS Tracking is the best possible tool for a woman to defend herself. This paper provides an algorithm to develop an equipment which a victim can use to defend herself by stunning the opposition with a high electric current and at the same time she can send an alert message with her current location to her closed ones.

For sudden attacks, external button can be provided for activation of device. Flashlight can be integrated as an additional protection.

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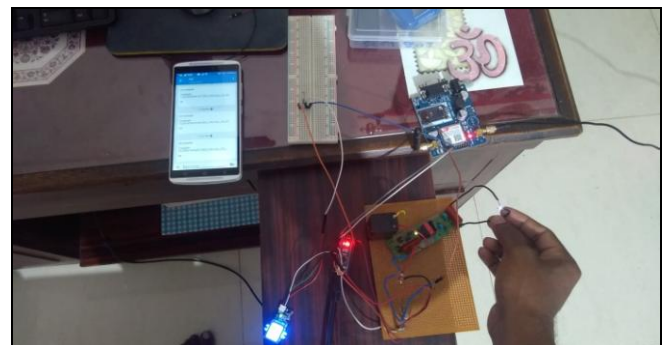
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